OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **McQUESTEN POND, MANCHESTER,** the program coordinators have made the following observations and recommendations:

Thank you for your continued hard work sampling the lake/pond this season! Your monitoring group sampled **four** times this season and has done so for many years! As you know, with multiple sampling events each season, we will be able to more accurately detect changes in water quality. Keep up the good work!

Please keep in mind that **McQUESTEN POND** is a ***very shallow*** (less than 1 meter at its deepest point) system which functions more like a wetland than a true lake or pond. Therefore, it may be inappropriate to compare this water body to other typical New Hampshire lakes and ponds. When reading this report, it is most important to focus on the trends observed in the pond itself since monitoring began in 2001.

FIGURE INTERPRETATION

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake/pond has been monitored through the program.

  Chlorophyll-a, a pigment found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **The mean (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 7.02 mg/m^3.**

The current year data (the top graph) show that the chlorophyll-a concentration ***decreased greatly*** from **May** to **July**. (Please note that the pond was not sampled for chlorophyll in June or August.)

The ***elevated*** chlorophyll concentration in **May** suggests that an **algal bloom** was occurring in the pond.

The historical data (the bottom graph) show that the 2004 chlorophyll-a mean is ***slightly greater than*** the state mean. In addition, the 2004 annual mean is the **second-highest** annual mean since monitoring began in 2001.

Overall, visual inspection of the historical data trend line (the bottom graph) shows a ***variable*** in-lake chlorophyll-a trend. Specifically, the mean concentration has ***fluctuated between approximately 1.09 and 21.27 mg/m³*** since ***2001.***

After 10 consecutive years of sample collection, we will be able to conduct a statistical analysis of the historical data to objectively determine if there has been a significant change in the annual mean chlorophyll-a concentration since monitoring began.

While algae are naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Algal concentrations may increase with an increase in nonpoint sources of phosphorus loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). Therefore, it is extremely important for volunteer monitors to continually educate residents about how activities within the watershed can affect phosphorus loading and lake/pond quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for lake/pond transparency. Table 3 (Appendix B) lists the maximum, minimum and mean transparency data for each sampling season that the lake/pond has been monitored through the program.

  Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.**

The transparency is not typically sampled in this pond since it very shallow at the deep spot (less than 1 meter).

Typically, high intensity rainfall causes erosion of sediments into lakes/ponds and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, lake/pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake/pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from DES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amount of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake/pond has joined the program.

  Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake/pond can lead to increases in plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 12 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

  The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration ***decreased steadily*** from **May** to **August**. The phosphorus concentration on **each sampling event** was ***much greater than*** the state median. This decreasing trend in phosphorus concentration as the summer progresses suggests that the pond receives the majority of its nutrient loading in the spring soon after snow-melt.

  The total phosphorus concentration in the epilimnion (upper layer) sample continued to be ***elevated*** on each sampling event. In addition, the turbidity continued to remain ***elevated***. The ***elevated phosphorus, turbidity, and chlorophyll*** levels suggest that the pond supports a high amount of biological activity and has a rich organic bottom.

  Overall, visual inspection of the historical data trend line for the epilimnion shows a ***relatively stable*** phosphorus trend since **2001** which is ***much greater than*** the state median. (It is interesting to note that the pond was sampled for phosphorus twice in 2000 and the results were atypically low.)

Please keep in mind that this trend is based on limited data. As your group expands its sampling program to include additional events each year, will be able to determine trends with more accuracy and confidence.

After 10 consecutive years of sample collection, we will be able to conduct a statistical analysis of the historical data to objectively determine if there has been a significant change in the annual mean phosphorus concentration since monitoring began.

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands.

TABLE INTERPRETATION

- **Table 2: Phytoplankton**
  Table 2 (Appendix B) lists the current and historical phytoplankton species observed in the lake/pond. Specifically, this table lists the three most dominant phytoplankton species observed in the sample and their relative abundance in the sample. In addition, this table has been enhanced this year to include the overall phytoplankton cell abundance rating of the sample. The overall phytoplankton cell abundance in a sample is calculated using a formula based on the relationship that DES biologists have observed over the years regarding phytoplankton concentrations, algal concentrations, and biological productivity in New Hampshire's lakes and ponds. A mathematical equation is used to classify the overall abundance of phytoplankton cells in a sample into the following categories: *sparse, scattered, moderate, common, abundant,* and *very abundant.* Generally, the more phytoplankton cells there are in a sample, the higher the chlorophyll concentration and the higher the biological productivity of the lake.

  This system is not typically sampled for phytoplankton.

  Phytoplankton populations undergo a natural succession during the growing season (Please refer to the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire's less productive lakes and ponds.

- **Table 4: pH**

Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 6.0 limits the growth and reproduction of fish. A pH between 6.0 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.6**, which indicates that the surface waters in the state are slightly acidic. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

The pH at the deep spot this season ranged from **6.46** to **6.85,** which means that the water is ***slightly acidic.***

Due to the presence of granite bedrock in the state and acid deposition (from snowmelt, rainfall, and atmospheric particulates) in New Hampshire, there is not much that can be done to effectively increase lake/pond pH.

- **Table 5: Acid Neutralizing Capacity**

Table 5 (Appendix B) presents the current year and historical epilimnetic ANC for each year the lake/pond has been monitored through VLAP.

Buffering capacity (ANC) describes the ability of a solution to resist changes in pH by neutralizing the acidic input. The mean ANC value for New Hampshire's lakes and ponds is **6.6 mg/L**, which indicates that many lakes and ponds in the state are at least "moderately vulnerable" to acidic inputs. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) ranged from **14.2** to **44 mg/L** this season, which is ***a very large range.*** This suggests that the pond water ***fluctuates*** between being ***moderately vulnerable*** to ***not vulnerable*** to acidic inputs. This suggests that the ANC of the pond depends upon the quality and timing of the stormwater that flows into the pond.

- **Table 6: Conductivity**
  Table 6 (Appendix B) presents the current and historical conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current (which is determined by the number of negatively charged ions from metals, salts, and minerals in the water column). The mean conductivity value for New Hampshire's lakes and ponds is **59.4 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

  The conductivity has ***remained elevated*** in the pond and inlets since monitoring began ***(generally ranging from approximately 500 – 700 uMhos/cm).***

  Typically, sources of elevated conductivity are due to human activity. These activities include septic systems that fail and leak leachate into the groundwater (and eventually into the tributaries and the pond), agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron deposits in bedrock, can influence conductivity.

  We recommend that your monitoring group conduct stream surveys and storm event sampling along the inlet(s) so that we can determine potential sources of conductivity to the pond.

  For a detailed explanation on how to conduct rain event sampling and stream surveys, please refer to the 2002 VLAP Annual Report "Special Topic Article" or contact the VLAP Coordinator.

  It is possible that de-icing materials applied to nearby roadways during the winter months may be influencing the conductivity in the lake/pond. In New Hampshire, the most commonly used de-icing material is salt (sodium chloride).

  Therefore, we recommend that the **pond** and the **inlets** be sampled for chloride soon after snow melt and during rain events. This sampling may help us pinpoint what areas of the watershed which are contributing to the increasing in-lake conductivity.

  Please note that there will be an additional cost for each of the chloride samples and that these samples must be analyzed at the DES laboratory in Concord.

Also, please read this year's Special Topic Article, "Conductivity is on the rise in New Hampshire's Lakes and Ponds: What is causing the increase and what can be done?" which is found in Appendix D of this report. This article may help your association understand what types of activities can lead to elevated conductivity and chloride levels and what residents can do to minimize this type of pollution.

- **Table 8: Total Phosphorus**

  Table 8 (Appendix B) presents the current year and historical total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae's ability to grow and reproduce. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

  The inlets were not sampled this season.

  It would be best to sample the inlet(s) in the spring soon after snowmelt or after a rain event to determine the quality of water that flows into the lake/pond.

- **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

  Table 9 (Appendix B) shows the dissolved oxygen/temperature profile(s) for the 2004 sampling season. Table 10 (Appendix B) shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

  The dissolved oxygen concentration was ***high*** at all depths sampled at the deep spot of the lake/pond on the **May, July, and August** sampling event. Typically, shallow lakes and ponds that are not deep enough to stratify into more than one or two thermal layers will have relatively high amounts of oxygen at all depths. This is due to continual lake mixing and diffusion of oxygen into the bottom waters induced by wind and wave action.

- **Table 11: Turbidity**

  Table 11 (Appendix B) lists the current year and historical data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the "Other Monitoring Parameters" section of this report for a more detailed explanation.

As discussed previously, the turbidity in the pond continued to be ***elevated*** on each sampling event. This suggests that the pond bottom is covered by a thick organic layer of sediment which is easily disturbed.

- **Table 12: Bacteria (*E.coli*)**

  Table 12 lists only the historical data for bacteria *(E.coli)* testing. (Please note that Table 12 now lists the maximum and minimum results for all past sampling seasons.) *E. coli* is a normal bacterium found in the large intestine of humans and other warm-blooded animals. *E.coli* is used as an indicator organism because it is easily cultured and its presence in the water, in defined amounts, indicates that sewage **MAY** be present. If sewage is present in the water, potentially harmful disease-causing organisms **MAY** also be present.

  It should be noted that bacteria sampling was not conducted this year. If residents are concerned about sources of bacteria such as failing septic systems, animal waste, or waterfowl waste, it is best to conduct *E. coli* testing when the water table is high, when beach use is heavy, or immediately after rain events.

- **Table 14: Current Year Biological and Chemical Raw Data**

  This table is a new addition to the Annual Report. This table lists the most current sampling season results. Since the maximum, minimum, and annual mean values for each parameter are not shown on this table, this table displays the current year "raw" (meaning unprocessed) data. The results are sorted by station, depth zone (epilimnion, metalimnion, and hypolimnion) and parameter.

- **Table 15: Station Table**

  This table is a new addition to the Annual Report. As of the Spring of 2004, all historical and current year VLAP data are included in the DES Environmental Monitoring Database (EMD). To facilitate the transfer of VLAP data into the EMD, a new station identification system had to be developed. While volunteer monitoring groups can still use the sampling station names that they have used in the past (and are most familiar with), an EMD station name also exists for each VLAP sampling location. For each station sampled at your lake or pond, Table 15 identifies what EMD station name corresponds to the station names you have used in the past and will continue to use in the future.

DATA QUALITY ASSURANCE AND CONTROL

Sample Receipt Checklist:

Each time your monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if the volunteer monitors followed proper sampling techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques.

Overall, the sample receipt checklist showed that your monitoring group did an ***excellent*** job when collecting samples and submitting them to the laboratory this season! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the laboratory staff to contact your group with questions, and no samples were rejected for analysis.

USEFUL RESOURCES

Acid Deposition Impacting New Hampshire's Ecosystems, NHDES Fact Sheet ARD-32, (603) 271-2975 or www.des.state.nh.us/factsheets/ard/ard-32.htm.

Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials, NHDES Booklet WD-03-42, (603) 271-2975.

Best Management Practices for Well Drilling Operations, NHDES Fact Sheet WD-WSEB-21-4, (603) 271-2975 or www.des.nh.gov/factsheets/ws/ws-21-4.htm.

Canada Geese Facts and Management Options, NHDES Fact Sheet BB-53, (603) 271-2975 or www.des.state.nh.us/factsheets/bb/bb-53.htm.

Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms, NHDES Fact Sheet WMB-10, (603) 271-2975 or www.des.state.nh.us/factsheets/wmb/wmb-10.htm.

Erosion Control for Construction in the Protected Shoreland Buffer Zone, NHDES Fact Sheet WD-SP-1, (603) 271-2975 or www.des.state.nh.us/factsheets/sp/sp-1.htm.

Freshwater Jellyfish In New Hampshire, NHDES Fact Sheet WD-BB-5, (603) 271-2975 or www.des.state.nh.us/factsheets/bb/bb-51/htm.

Impacts of Development Upon Stormwater Runoff, NHDES Fact Sheet WD-WQE-7, (603) 271-2975 or www.des.state.nh.us/factsheets/wqe/wqe-7.htm.

IPM: An Alternative to Pesticides, NHDES Fact Sheet WD-SP-3, (603) 271-2975 or www.des.state.nh.us/factsheets/sp/sp-3.htm.

Iron Bacteria in Surface Water, NHDES Fact Sheet WD-BB-18, (603) 271-2975 or www.des.state.nh.us/factsheets/bb/bb-18.htm.

Lake Foam, NHDES Fact Sheet WD-BB-4, (603) 271-2975 or www.des.state.nh.us/factsheets/bb/bb-5.htm.

Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, NHDES Fact Sheet WD-BB-9, (603) 271-2975 or www.des.state.nh.us/factsheets/bb/bb-9.htm.

Proper Lawn Care In the Protected Shoreland, The Comprehensive Shoreland Protection Act, NHDES Fact Sheet WD-SP-2, (603) 271-2975 or www.des.state.nh.us/factsheets/sp/sp-2.htm.

Road Salt and Water Quality, NHDES Fact Sheet WD-WMB-4, (603) 271-2975 or www.des.state.nh.us/factsheets/wmb/wmb-4.htm.

Sand Dumping - Beach Construction, NHDES Fact Sheet WD-BB-15, (603) 271-2975 or www.des.state.nh.us/factsheets/bb/bb-15.htm.

Shorelands Under the Jurisdiction of the Comprehensive Shoreland Protection Act, NHDES Fact Sheet SP-4, (603) 271-2975 or www.des.state.nh.us/factsheets/sp/sp-4.htm.

Soil Erosion and Sediment Control on Construction Sites, NHDES Fact Sheet WQE-6, (603) 271-2975 or www.des.state.nh.us/factsheets/wqe/wqe-6.htm.

Swimmers Itch, NHDES Fact Sheet WD-BB-2, (603) 271-2975 or www.des.state.nh.us/factsheets/bb/bb-2.htm.

Through the Looking Glass: A Field Guide to Aquatic Plants, North American Lake Management Society, 1988, (608) 233-2836 or www.nalms.org.

Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, NHDES Fact Sheet WD-BB-4, (603) 271-2975 or www.des.state.nh.us/factsheets/bb/bb-4.htm.